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ART-UNIT: 3765

PRIMARY-EXAMINER: Vanatta; A.

ATTY-AGENT-FIRM: Dority & Manning, P.A.

ABSTRACT:

A nonwoven composite fabric is provided that contains one or more abraded (e.g., sanded) surfaces. In addition to improving the softness and handfeel of the nonwoven composite fabric, it has been unexpectedly discovered that abrading such a fabric may also impart excellent liquid handling properties (e.g., absorbent capacity, absorbent rate, wicking rate, etc.), as well as improved bulk and capillary tension.

33 Claims, 11 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 6

Brief Summary Text - BSTX (3):

In the past, nonwoven fabrics, such as meltblown nonwoven webs, have been widely used as wipers. Meltblown nonwoven webs possess an interfiber capillary structure that is suitable for absorbing and retaining liquid. However, meltblown nonwoven webs sometimes lack the requisite physical properties for use as a heavy-duty wiper, e.g., tear strength and abrasion resistance. Consequently, meltblown nonwoven webs are typically laminated to a support layer, e.g., a nonwoven web, which may not be desirable for use on abrasive or rough surfaces. Spunbond webs contain thicker and stronger **fibers** than meltblown nonwoven webs and may provide good physical properties, such as tear strength and abrasion resistance. However, spunbond webs sometimes lack fine interfiber capillary structures that enhance the adsorption characteristics of the wiper. Furthermore, spunbond webs often contain bond points that may inhibit the flow or transfer of liquid within the nonwoven webs.

Brief Summary Text - BSTX (4):

In response to these and other problems, nonwoven composite fabrics were developed in which pulp **fibers** were hydroentangled with a nonwoven layer of substantially continuous filaments. Many of these fabrics possessed good levels of strength, but often exhibited inadequate softness and handfeel. For example, hydroentanglement relies on high water volumes and pressures to entangle the **fibers**. Residual water may be removed through a series of drying cans. However, the high water pressures and the relatively high temperature of the drying cans essentially compresses or compacts the **fibers** into a stiff structure. Thus, techniques were developed in an attempt to soften nonwoven composite fabrics without reducing strength to a significant extent. One such technique is described in U.S. Pat. No. 6,103,061 to Anderson, et al., which is incorporated herein in

its entirety by reference thereto for all purposes. Anderson, et al. is directed to a nonwoven composite fabric that is subjected to mechanical softening, such as creping. Other attempts to soften composite materials included the addition of chemical agents, calendaring, and embossing. Despite these improvements, however, nonwoven composite fabrics still lack the level of softness and handfeel required to give them a "clothlike" feel.

Brief Summary Text - BSTX (7):

In accordance with one embodiment of the present invention, a method for forming a fabric is disclosed that comprises providing a nonwoven web that contains thermoplastic **fibers**. The nonwoven web is entangled with staple **fibers** to form a composite material. The composite material defines a first surface and a second surface. The first surface of the composite material is abraded.

Brief Summary Text - BSTX (8):

In accordance with another embodiment of the present invention, a method for forming a fabric is disclosed that comprises providing a nonwoven web that contains thermoplastic continuous **fibers**. The nonwoven web is hydraulically entangled with pulp **fibers** to form a composite material. The pulp **fibers** comprise greater than about 50 wt. % of the composite material. The composite material defines a first surface and a second surface. The first surface of the composite material is abraded.

Brief Summary Text - BSTX (9):

In accordance with still another embodiment of the present invention, a method for forming a fabric is disclosed that comprises providing a spunbond web that contains thermoplastic polyolefin **fibers**. The spunbond web is hydraulically entangled with pulp **fibers** to form a composite material. The pulp **fibers** comprise from about 60 wt. % to about 90 wt. % of the composite material. The composite material defines a first surface and a second surface. The first surface of the composite material is sanded.

Brief Summary Text - BSTX (10):

In accordance with yet another embodiment of the present invention, a composite fabric is disclosed that comprises a spunbond web that contains thermoplastic polyolefin **fibers**. The spunbond web is hydraulically entangled with pulp **fibers**. The pulp **fibers** comprise greater than about 50 wt. % of the composite fabric, wherein at least one surface of the composite fabric is abraded. In some embodiments, the abraded surface may contain **fibers** aligned in a more uniform direction than **fibers** of an unabraded surface of an otherwise identical composite fabric. In addition, the abraded surface may

contain a greater number of exposed **fibers** than an unabraded surface of an otherwise identical composite fabric.

Description Paragraph - DETX (18):

As used herein, the term "nonwoven web" refers to a web having a structure of individual **fibers** or threads that are interlaid, but not in an identifiable manner as in a knitted fabric. Nonwoven webs include, for example, meltblown webs, spunbond webs, carded webs, airlaid webs, etc.

Description Paragraph - DETX (19):

As used herein, the term "spunbond web" refers to a nonwoven web formed from small diameter substantially continuous **fibers**. The **fibers** are formed by extruding a molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries of a spinnerette with the diameter of the extruded **fibers** then being rapidly reduced as by, for example, eductive drawing and/or other well-known spunbonding mechanisms. The production of spunbond webs is described and illustrated, for example, in U.S. Pat. No. 4,340,563 to Appel, et al., U.S. Pat. No. 3,692,618 to Dorschner, et al., U.S. Pat. No. 3,802,817 to Matsuki, et al., U.S. Pat. No. 3,338,992 to Kinney, U.S. Pat. No. 3,341,394 to Kinney, U.S. Pat. No. 3,502,763 to Hartman, U.S. Pat. No. 3,502,538 to Levy, U.S. Pat. No. 3,542,615 to Dobo, et al., and U.S. Pat. No. 5,382,400 to Pike, et al., which are incorporated herein in their entirety by reference thereto for all purposes. Spunbond **fibers** are generally not tacky when they are deposited onto a collecting surface. Spunbond **fibers** may sometimes have diameters less than about 40 microns, and are often from about 5 to about 20 microns.

Description Paragraph - DETX (20):

As used herein, the term "meltblown web" refers to a nonwoven web formed from **fibers** extruded through a plurality of fine, usually circular, die capillaries as molten **fibers** into converging high velocity gas (e.g. air) streams that attenuate the **fibers** of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown **fibers** are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly disbursed meltblown **fibers**. Such a process is disclosed, for example, in U.S. Pat. No. 3,849,241 to Butin, et al., which is incorporated herein in its entirety by reference thereto for all purposes. In some instances, meltblown **fibers** may be microfibers that may be continuous or discontinuous, are generally smaller than 10 microns in diameter, and are generally tacky when deposited onto a collecting surface.

Description Paragraph - DETX (21):

As used herein, the term "multicomponent **fibers**" or "conjugate **fibers**" refers to **fibers** that have been formed from at least two polymer components. Such **fibers** are usually extruded from separate extruders but spun together to form one **fiber**. The polymers of the respective components are usually different from each other although multicomponent **fibers** may include separate components of similar or identical polymeric materials. The individual components are typically arranged in substantially constantly positioned distinct zones across the cross-section of the **fiber** and extend substantially along the entire length of the **fiber**. The configuration of such **fibers** may be, for example, a side-by-side arrangement, a pie arrangement, or any other arrangement. **Bicomponent fibers** and methods of making the same are taught in U.S. Pat. No. 5,108,820 to Kaneko, et al., U.S. Pat. No. 4,795,668 to Kruege, et al., U.S. Pat. No. 5,382,400 to Pike, et al., U.S. Pat. No. 5,336,552 to Strack, et al., and U.S. Pat. No. 6,200,669 to Marmon, et al., which are incorporated herein in their entirety by reference thereto for all purposes. The **fibers** and individual components containing the same may also have various irregular shapes such as those described in U.S. Patent. No. 5,277,976 to Hogle, et al., U.S. Pat. No. 5,162,074 to Hills, U.S. Pat. No. 5,466,410 to Hills, U.S. Pat. No. 5,069,970 to Largman, et al., and U.S. Pat. No. 5,057,368 to Largman, et al., which are incorporated herein in their entirety by reference thereto for all purposes.

Description Paragraph - DETX (22):

As used herein, the term "average **fiber** length" refers to a weighted average length of pulp **fibers** determined utilizing a Kajaani **fiber** analyzer model No. FS-100 available from Kajaani Oy Electronics, Kajaani, Finland. According to the test procedure, a pulp sample is treated with a macerating liquid to ensure that no **fiber** bundles or shives are present. Each pulp sample is disintegrated into hot water and diluted to an approximately 0.001% solution. Individual test samples are drawn in approximately 50 to 100 ml portions from the dilute solution when tested using the standard Kajaani **fiber** analysis test procedure. The weighted average **fiber** length may be expressed by the following equation:

Description Paragraph - DETX (25):

k=maximum **fiber** length

Description Paragraph - DETX (26):

x.sub.i= **fiber** length

Description Paragraph - DETX (27):

n.sub.i=number of **fibers** having length x.sub.i; and

Description Paragraph - DETX (28):

n=total number of **fibers** measured.

Description Paragraph - DETX (29):

As used herein, the term "low-average **fiber** length pulp" refers to pulp that contains a significant amount of short **fibers** and non **-fiber** particles. Many secondary wood **fiber** pulps may be considered low average **fiber** length pulps; however, the quality of the secondary wood **fiber** pulp will depend on the quality of the recycled **fibers** and the type and amount of previous processing. Low-average **fiber** length pulps may have an average **fiber** length of less than about 1.2 millimeters as determined by an optical **fiber** analyzer such as, for example, a Kajaani **fiber** analyzer model No. FS-100 (Kajaani Oy Electronics, Kajaani, Finland). For example, low average **fiber** length pulps may have an average **fiber** length ranging from about 0.7 to about 1.2 millimeters.

Description Paragraph - DETX (30):

As used herein, the term "high-average **fiber** length pulp" refers to pulp that contains a relatively small amount of short **fibers** and non **-fiber** particles. High-average **fiber** length pulp is typically formed from certain non-secondary (i.e., virgin) **fibers**. Secondary **fiber** pulp that has been screened may also have a high-average **fiber** length. High-average **fiber** length pulps typically have an average **fiber** length of greater than about 1.5 millimeters as determined by an optical **fiber** analyzer such as, for example, a Kajaani **fiber** analyzer model No. FS-100 (Kajaani Oy Electronics, Kajaani, Finland). For example, a high-average **fiber** length pulp may have an average **fiber** length from about 1.5 to about 6 millimeters.

Description Paragraph - DETX (33):

The nonwoven composite fabric contains absorbent staple **fibers** and thermoplastic **fibers,** which is beneficial for a variety of reasons. For example, the thermoplastic **fibers** of the nonwoven composite fabric may improve strength, durability, and oil absorption properties. Likewise, the absorbent staple **fibers** may improve bulk, handfeel, and water absorption properties. The relative amounts of the thermoplastic **fibers** and absorbent staple **fibers** used in the nonwoven composite fabric may vary depending on the desired properties. For instance, the thermoplastic **fibers** may comprise less than about 50% by weight of the nonwoven composite fabric, and in some embodiments, from about 10% to about 40% by weight of the nonwoven composite fabric. Likewise, the absorbent staple **fibers** may comprise greater than about 50% by weight of the nonwoven composite fabric, and in some embodiments, from about 60% to about 90% by weight of the nonwoven composite fabric.

Description Paragraph - DETX (34):

The absorbent staple **fibers** may be formed from a variety of different materials. For example, in one embodiment, the absorbent staple **fibers** are non-thermoplastic, and contain cellulosic **fibers** (e.g., pulp, thermomechanical pulp, synthetic cellulosic **fibers,** modified cellulosic **fibers,** and so forth), as well as other types of non-thermoplastic **fibers** (e.g., synthetic staple **fibers**). Some examples of suitable cellulosic **fiber** sources include virgin wood **fibers,** such as thermomechanical, bleached and unbleached softwood and hardwood pulps. Secondary or recycled **fibers,** such as obtained from office waste, newsprint, brown paper stock, paperboard scrap, etc., may also be used. Further, vegetable **fibers,** such as abaca, flax, milkweed, cotton, modified cotton, cotton linters, may also be used. In addition, synthetic cellulosic **fibers** such as, for example, rayon and viscose rayon may be used. Modified cellulosic **fibers** may also be used. For example, the absorbent staple **fibers** may be composed of derivatives of cellulose formed by substitution of appropriate radicals (e.g., carboxyl, alkyl, acetate, nitrate, etc.) for hydroxyl groups along the carbon chain. As stated, non-cellulosic **fibers** may also be utilized as absorbent staple **fibers**. Some examples of such absorbent staple **fibers** include, but are not limited to, acetate staple **fibers,** Nomex.RTM. staple **fibers,** Kevlar.RTM. staple **fibers,** polyvinyl alcohol staple **fibers,** lyocel staple **fibers,** and so forth.

Description Paragraph - DETX (35):

When utilized as absorbent staple **fibers,** pulp **fibers** may have a high-average **fiber** length, a low-average **fiber** length, or mixtures of the same. Some examples of suitable high-average length pulp **fibers** include, but are not limited to, northern softwood, southern softwood, redwood, red cedar, hemlock, pine (e.g., southern pines), spruce (e.g., black spruce), combinations thereof, and so forth. Exemplary high-average **fiber** length wood pulps include those available from the Kimberly-Clark Corporation under the trade designation "Longlac 19". Some examples of suitable low-average **fiber** length pulp **fibers** may include, but are not limited to, certain virgin hardwood pulps and secondary (i.e. recycled) **fiber** pulp from sources such as, for example, newsprint, reclaimed paperboard, and office waste. Hardwood **fibers,** such as eucalyptus, maple, birch, aspen, and so forth, may also be used as low-average length pulp **fibers**. Mixtures of high-average **fiber** length and low-average **fiber** length pulps may be used. For example, a mixture may contain more than about 50% by weight low-average **fiber** length pulp and less than about 50% by weight high-average **fiber** length pulp. One exemplary mixture contains 75% by weight low-average **fiber** length pulp and about 25% by weight high-average **fiber** length pulp.

Description Paragraph - DETX (36):

As stated, the nonwoven composite fabric also contains thermoplastic **fibers**. The thermoplastic **fibers** may be substantially continuous, or may be staple **fibers** having an average **fiber** length of from about 0.1 millimeters to about 25 millimeters, in some embodiments from about 0.5 millimeters to about 10 millimeters, and in some embodiments, from about 0.7 millimeters to about 6 millimeters. Regardless of **fiber** length, the thermoplastic **fibers** may be formed from a variety of different types of polymers including, but not limited to, polyolefins, **polyamides,** polyesters, polyurethanes, blends and copolymers thereof, and so forth. Desirably, the thermoplastic **fibers** contain polyolefins, and even more desirably, polypropylene and/or polyethylene. Suitable polymer compositions may also have thermoplastic elastomers blended therein, as well as contain pigments, antioxidants, flow promoters, stabilizers, fragrances, abrasive particles, fillers, and so forth. Optionally, multicomponent (e.g., **bicomponent**) thermoplastic **fibers** are utilized. For example, suitable configurations for the multicomponent **fibers** include side-by-side configurations and **sheath-core** configurations, and suitable **sheath-core** configurations include eccentric **sheath-core** and concentric **sheath-core** configurations. In some embodiments, as is well known in the art, the polymers used to form the multicomponent **fibers** have sufficiently different melting points to form different crystallization and/or solidification properties. The multicomponent **fibers** may have from about 20% to about 80%, and in some embodiments, from about 40% to about 60% by weight of the low melting polymer. Further, the multicomponent **fibers** may have from about 80% to about 20%, and in some embodiments, from about 60% to about 40%, by weight of the high melting polymer.

Description Paragraph - DETX (37):

Besides thermoplastic **fibers** and absorbent staple **fibers,** the nonwoven composite fabric may also contain various other materials. For instance, small amounts of wet-strength resins and/or resin binders may be utilized to improve strength and abrasion resistance. Debonding agents may also be utilized to reduce the degree of hydrogen bonding. The addition of certain debonding agents in the amount of, for example, about 1% to about 4% percent by weight of a composite layer may also reduce the measured static and dynamic coefficients of friction and improve abrasion resistance. Various other materials such as, for example, activated charcoal, clays, starches, superabsorbent materials, etc., may also be utilized.

Description Paragraph - DETX (38):

In some embodiments, for instance, the nonwoven composite fabric is formed by integrally entangling thermoplastic **fibers** with absorbent staple **fibers** using any of a variety of entanglement techniques known in the art (e.g., hydraulic, air, mechanical, etc.). For example, in one embodiment, a nonwoven web formed from thermoplastic

fibers is integrally entangled with absorbent staple **fibers** using hydraulic entanglement. A typical hydraulic entangling process utilizes high pressure jet streams of water to entangle **fibers** and/or filaments to form a highly entangled consolidated composite structure. Hydraulic entangled nonwoven composite materials are disclosed, for example, in U.S. Pat. No. 3,494,821 to Evans; U.S. Pat. No. 4,144,370 to Bouolton; U.S. Pat. No. 5,284,703 to Everhart, et al.; and U.S. Pat. No. 6,315,864 to Anderson, et al., which are incorporated herein in their entirety by reference thereto for all purposes.

Description Paragraph - DETX (39):

Referring to FIG. 1, for instance, one embodiment of a hydraulic entangling process suitable for forming a nonwoven composite fabric from a nonwoven web and pulp **fibers** is illustrated. As shown, a fibrous slurry containing pulp **fibers** is conveyed to a conventional papermaking headbox 12 where it is deposited via a sluice 14 onto a conventional forming fabric or surface 16. The suspension of pulp **fibers** may have any consistency that is typically used in conventional papermaking processes. For example, the suspension may contain from about 0.01 to about 1.5 percent by weight pulp **fibers** suspended in water. Water is then removed from the suspension of pulp **fibers** to form a uniform layer 18 of the pulp **fibers**.

Description Paragraph - DETX (40):

A nonwoven web 20 is also unwound from a rotating supply roll 22 and passes through a nip 24 of a S-roll arrangement 26 formed by the stack rollers 28 and 30. Any of a variety of techniques may be used to form the nonwoven web 20. For instance, in one embodiment, staple **fibers** are used to form the nonwoven web 20 using a conventional carding process, e.g., a woolen or cotton carding process. Other processes, however, such as air laid or wet laid processes, may also be used to form a staple **fiber** web. In addition, substantially continuous **fibers** may be used to form the nonwoven web 20, such as those formed by melt-spinning process, such as spunbonding, meltblowing, etc.

Description Paragraph - DETX (43):

Returning again to FIG. 1, the nonwoven web 20 is then placed upon a foraminous entangling surface 32 of a conventional hydraulic entangling machine where the pulp **fiber** layer 18 are then laid on the web 20. Although not required, it is typically desired that the pulp **fiber** layer 18 be positioned between the nonwoven web 20 and the hydraulic entangling manifolds 34. The pulp **fiber** layer 18 and the nonwoven web 20 pass under one or more hydraulic entangling manifolds 34 and are treated with jets of fluid to entangle the pulp **fiber** layer 18 with the **fibers** of the nonwoven web 20, and drive them into and through the nonwoven web 20 to form a nonwoven composite fabric 36. Alternatively, hydraulic entangling may take place while the pulp **fiber** layer 18 and the nonwoven web 20 are on the same foraminous screen (e.g., mesh fabric) that the wet-

laying took place. The present invention also contemplates superposing a dried pulp **fiber** layer 18 on the nonwoven web 20, rehydrating the dried sheet to a specified consistency and then subjecting the rehydrated sheet to hydraulic entangling. The hydraulic entangling may take place while the pulp **fiber** layer 18 is highly saturated with water. For example, the pulp **fiber** layer 18 may contain up to about 90% by weight water just before hydraulic entangling. Alternatively, the pulp **fiber** layer 18 may be an air-laid or dry-laid layer.

Description Paragraph - DETX (45):

Fluid may impact the pulp **fiber** layer 18 and the nonwoven web 20, which are supported by a foraminous surface, such as a single plane mesh having a mesh size of from about 40.times.40 to about 100.times.100. The foraminous surface may also be a multi-ply mesh having a mesh size from about 50.times.50 to about 200.times.200. As is typical in many water jet treatment processes, vacuum slots 38 may be located directly beneath the hydro-needling manifolds or beneath the foraminous entangling surface 32 downstream of the entangling manifold so that excess water is withdrawn from the hydraulically entangled nonwoven composite fabric 36.

Description Paragraph - DETX (46):

Although not held to any particular theory of operation, it is believed that the columnar jets of working fluid that directly impact the pulp **fiber** layer 18 laying on the nonwoven web 20 work to drive the pulp **fibers** into and partially through the matrix or network of **fibers** in the nonwoven web 20. When the fluid jets and the pulp **fiber** layer 18 interact with the nonwoven web 20, the pulp **fibers** of the layer 18 are also entangled with the **fibers** of the nonwoven web 20 and with each other. In some embodiments, such entanglement may result in a material having a "sidedness" in that one surface has a preponderance of the thermoplastic **fibers,** giving it a slicker, more plastic-like feel, while another surface has a preponderance of pulp **fibers,** giving it a softer, more consistent feel. That is, although the pulp **fibers** of the layer 18 are driven through and into the matrix of the nonwoven web 20, many of the pulp **fibers** will still remain at or near a surface of the material 36. This surface may thus contain a greater proportion of pulp **fibers,** while the other surface may contain a greater proportion of the thermoplastic **fibers** of the nonwoven web 20.

Description Paragraph - DETX (48):

In addition to a hydraulically entangled nonwoven composite fabric, the nonwoven composite fabric may also contain a blend of thermoplastic **fibers** and absorbent staple **fibers**. For instance, the nonwoven composite fabric may be a "coform" material, which may be made by a process in which at least one meltblown die head is arranged near a chute through which absorbent staple **fibers** are added to the nonwoven web while it

forms. Some examples of such coform materials are disclosed in U.S. Pat. No. 4,100,324 to Anderson, et al.; U.S. Pat. No. 5,284,703 to Everhart, et al.; and U.S. Pat. No. 5,350,624 to Georger, et al.; which are incorporated herein in their entirety by reference thereto for all purposes.

Description Paragraph - DETX (52):

As described above, the composite fabric 36 may sometimes have a "sidedness" with one surface having a preponderance of staple **fibers** (e.g., pulp **fibers**). In one embodiment, the surface 90 of the composite fabric 36 that is abraded may contain a preponderance of staple **fibers**. In addition, the surface 90 may contain a preponderance of thermoplastic **fibers** from the nonwoven web. The present inventors have surprisingly discovered that, apart from improving softness and handfeel, abrading one or more surfaces may also enhance other physical properties of the fabric, such as bulk, absorption rate, wicking rate, and absorption capacity. Although not intending to be limited by theory, the abrasive surface combs, naps, and/or raises the surface **fibers** with which it contacts. Consequently, the **fibers** are mechanically re-arranged and somewhat pulled out from the matrix of the composite material. These raised **fibers** may be, for instance, pulp **fibers** and/or thermoplastic **fibers**. Regardless, the **fibers** on the surface exhibit a more uniform appearance and enhance the handfeel of the fabric, creating a more "cloth like" material.

Description Paragraph - DETX (59):

Before or after abrading the composite fabric 36, it may also be desirable to use other finishing steps and/or post treatment processes to impart selected properties to the composite fabric 36. For example, the composite fabric 36 may be lightly pressed by calender rolls, or otherwise treated to enhance stretch and/or to provide a uniform exterior appearance and/or certain tactile properties. Alternatively or additionally, various chemical post-treatments such as, adhesives or dyes may be added to the composite fabric 36. Additional post-treatments that may be utilized are described in U.S. Pat. No. 5,853,859 to Levy, et al., which is incorporated herein in its entirety by reference thereto for all purposes. Further, the abraded surface of the composite fabric 36 may be vacuumed to remove any **fibers** that became free during the abrasion process.

Description Paragraph - DETX (68):

Grab Tensile Strength: The grab tensile test is a measure of breaking strength of a fabric when subjected to unidirectional stress. This test is known in the art and conforms to the specifications of Method 5100 of the Federal Test Methods Standard 191A. The results are expressed in pounds to break. Higher numbers indicate a stronger fabric. The grab tensile test uses two clamps, each having two jaws with each jaw having a facing in contact with the sample. The clamps hold the material in the same plane, usually

vertically, separated by 3 inches (76 mm) and move apart at a specified rate of extension. Values for grab tensile strength are obtained using a sample size of 4 inches (102 mm) by 6 inches (152 mm), with a jaw facing size of 1 inch (25 mm) by 1 inch, and a constant rate of extension of 300 mm/min. The sample is wider than the clamp jaws to give results representative of effective strength of **fibers** in the clamped width combined with additional strength contributed by adjacent **fibers** in the fabric. The specimen is clamped in, for example, a Sintech 2 tester, available from the Sintech Corporation of Cary, N.C., an Instron Model TM, available from the Instron Corporation of Canton, Mass., or a Thwing-Albert Model INTELLECT II available from the Thwing-Albert Instrument Co. of Philadelphia, Pa. This closely simulates fabric stress conditions in actual use. Results are reported as an average of three specimens and may be performed with the specimen in the cross direction (CD) or the machine direction (MD).

Description Paragraph - DETX (69):

Water Intake Rate: The intake rate of water is the time required, in seconds, for a sample to completely absorb the liquid into the web versus sitting on the material surface. Specifically, the intake of water is determined according to ASTM No. 2410 by delivering 0.5 cubic centimeters of water with a pipette to the material surface. Four (4) 0.5-cubic centimeter drops of water (2 drops per side) are applied to each material surface. The average time for the four drops of water to **wick** into the material (z-direction) is recorded. Lower absorption times, as measured in seconds, are indicative of a faster intake rate. The test is run at conditions of 73.4.degree..+.3.6.degree. F. and 50%.+.5% relative humidity.

Description Paragraph - DETX (76):

Wypall.RTM. X80 Red wipers and Wypall.RTM. X80 Blue Steel wipers, which are commercially available from Kimberly-Clark Corporation, were provided. The wipers were formed from nonwoven composite materials in substantial accordance with U.S. Pat. No. 5,284,703 to Everhart, et al. Specifically, the wipers had a basis weight of 125 grams per square meter (gsm), and were formed from a spunbond polypropylene web (22.7 gsm) hydraulically entangled with northern softwood kraft **fibers**.

Description Paragraph - DETX (77):

The wipers were abraded under various conditions using a 620 Series microgrinder obtained from Curtin-Hebert Co., Inc. of Gloversville, N.Y., which is substantially similar to the device shown in FIG. 2. Specifically, each wiper was first abraded on its pulp-side and tested for various properties (1 pass). Thereafter, the spunbond-side of the wipers was abraded (2 pass) using the identical abrasion conditions. The abrasion roll in each pass oscillated 0.25 inches in the cross-direction of the samples to ensure that the roll did not become filled with **fibers** and that grooves were not worn into the roll.

Description Paragraph - DETX (84):

SEM photographs of the non-abraded Wypall.RTM. Red wiper control sample are shown in FIG. 6 (pulp side), FIG. 7 (45 degree angle), and FIG. 8 (spunbond side). The control sample shows **fibers** intertwined together and compacted on the surfaces.

Description Paragraph - DETX (85):

SEM photographs of the Wypall.RTM. Red wiper abraded at a gap of 0.014 inches and a line speed of 17 feet per minute are shown in FIG. 9 (pulp side, 1 pass) and FIG. 10 (spunbond side, 2 pass). As shown in FIG. 9, the surface **fibers** are aligned in a more uniform direction (sanding direction) and possess a larger number of exposed **fibers** relative to the control sample. Likewise, FIG. 10 shows the abraded sample with **fibers** more uniform in size and aligned in the same direction. The **fibers** also cover a greater area of the exposed thermal bond points of the underlying spunbond web.

Description Paragraph - DETX (87):

Wypall.RTM. X80 Blue Steel wipers, which are commercially available from Kimberly-Clark Corporation, were provided. The wipers were formed from nonwoven composite materials in substantial accordance with U.S. Pat. No. 5,284,703 to Everhart, et al. Specifically, the wipers had a basis weight of 125 grams per square meter (gsm), and were formed from a spunbond polypropylene web (22.7 gsm) hydraulically entangled with northern softwood kraft **fibers**.

Description Paragraph - DETX (88):

The wipers were abraded under various conditions using a 620 Series microgrinder obtained from Curtin-Hebert Co., Inc. of Gloversville, N.Y., which is substantially similar to the sander shown in FIG. 2. Specifically, each sample was first abraded on its pulp-side (1 pass) and tested for various properties. Thereafter, one of the samples was also abraded on the spunbond-side (2 pass) using the identical abrasion conditions. The abrasion roll in each pass oscillated 0.25 inches in the cross-direction of the samples to ensure that the roll did not become filled with **fibers** and that grooves were not worn into the roll.

Description Paragraph - DETX (94):

As indicated, various properties of the abraded samples were improved in comparison to the non-abraded control samples. In addition, as indicated, greater gap distances generally resulted in a lower reduction of strength. On the other hand, smaller gap distances had a greater impact on certain properties, such as liquid capacity and intake rate. FIG. 11 is an SEM photograph of Sample 4 (45 degree angle). The surface **fibers** of

the abraded sample shown in FIG. 11 are aligned in a uniform direction (sanding direction).

Description Paragraph - DETX (97):

The single-ply wipers were Wypall.RTM. X80 Red wipers, which are commercially available from Kimberly-Clark Corporation. Wypall.RTM.X80 Red wipers are nonwoven composite materials made in substantial accordance with U.S. Pat. No. 5,284,703 to Everhart, et al. Specifically, the wipers have a basis weight of 125 grams per square meter (gsm), and are formed from a spunbond polypropylene web (22.7 gsm) hydraulically entangled with northern softwood kraft **fibers**.

Description Paragraph - DETX (98):

Each ply of the two-ply wiper was a Wypall.RTM. X60 wiper, which is commercially available from Kimberly-Clark Corporation. Wypall.RTM. X60 wipers are nonwoven composite materials made in substantial accordance with U.S. Pat. No. 5,284,703 to Everhart, et al. Specifically, the wipers have a basis weight of 64 grams per square meter (gsm), and are formed from a spunbond polypropylene web (11.3 gsm) hydraulically entangled with northern softwood kraft **fibers**.

Description Paragraph - DETX (102):

Samples 7 13 were abraded using a roll wrapped with sandpaper. For samples 7 8, 10, 12, and 14, only the pulp side was abraded. For samples 9, 11, and 13, both sides were abraded. The sandpaper rolls were formed from a standard paper **core** having an outside diameter of 3 inches. The rolls were cut to a length of 10.5 inches, and wrapped with sandpaper having a grit size of 60 (avg. particle size of 254 microns). Samples 7 and 9 14 were wrapped lengthwise to form a single seam. Sample 8 was wrapped with individual 2-inch strips spaced apart 0.5 inches. The rolls were mounted onto separate electrically-driven unwind stands, and positioned against the surface of the sample as it was wound under tension between an unwind and power winder. The rolls rotated in a direction opposite to that of the moving samples at a speed of 1800 feet per minute. A quick draft vacuum was positioned near the surface of the sample to remove dust, particles, etc., generated during abrasion.

Claims Text - CLTX (1):

1. A method for forming a fabric comprising: providing a nonwoven web that contains thermoplastic **fibers**; entangling said nonwoven web with absorbent staple **fibers** to form a composite material, said composite material defining a first surface and a second surface; and abrading said first surface of said composite material by contacting said first surface of said composite material with abrasive particles, wherein said abrading is

carried out by contacting said first surface of said composite material with a roll that rotates in a clockwise or counterclockwise direction.

Claims Text - CLTX (3):

3. A method as defined in claim 2, wherein said spunbond web comprises polyolefin **fibers**.

Claims Text - CLTX (4):

4. A method as defined in claim 1, wherein said absorbent staple **fibers** comprise greater than about 50 wt. % of said composite material.

Claims Text - CLTX (5):

5. A method as defined in claim 1, wherein said absorbent staple **fibers** comprise from about 60 wt. % to about 90 wt. % by weight of said composite material.

Claims Text - CLTX (6):

6. A method as defined in claim 1, wherein said nonwoven web is hydraulically entangled with said absorbent staple **fibers**.

Claims Text - CLTX (18):

18. A method for forming a fabric comprising: providing a nonwoven web that contains thermoplastic continuous **fibers**; hydraulically entangling said nonwoven web with pulp **fibers** to form a composite material, said pulp **fibers** comprising greater than about 50 wt. % of said composite material, said composite material defining a first surface and a second surface; and abrading said first surface of said composite material by contacting said first surface of said composite material with abrasive particles, wherein said abrasion is carried out by contacting said first surface of said composite material with a roll that rotates in a clockwise or counterclockwise direction.

Claims Text - CLTX (19):

19. A method as defined in claim 18, wherein said nonwoven web is a spunbond web that comprises polyolefin **fibers**.

Claims Text - CLTX (20):

20. A method as defined in claim 18, wherein said pulp **fibers** comprise from about 60% to about 90% by weight of said composite material.

Claims Text - CLTX (31):

31. A method for forming a fabric comprising: providing a spunbond web that contains thermoplastic polyolefin **fibers**; hydraulically entangling said spunbond web with pulp **fibers** to form a composite material, said pulp **fibers** comprising from about 60 wt. % to about 90 wt. % of said composite material, said composite material defining a first surface and a second surface; and sanding said first surface of said composite material with sand paper, wherein said sand paper is wrapped around a roll that rotates in a clockwise or counterclockwise direction.

flows to substantially fills the interstices of the web. Accordingly, the porosity of the resultant pad can also be adjusted by selection of